Diversity in Pediatric Behavioral Sleep Intervention Studies

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Summary

Studies designed to assess the efficacy of behavioral sleep interventions for infants and young children often report sleep improvements, but the generalization to children and families of diverse backgrounds is rarely assessed. The present study describes a systematic review of the racial, ethnic, and socioeconomic diversity of behavioral sleep intervention studies for young children. Thirty-two behavioral sleep intervention studies (5,474 children) were identified using PRISMA guidelines. Each study was coded for racial and ethnic composition, parental educational attainment (an index of socioeconomic resources), and country of origin. Racial or ethnic information was obtained for 19 studies (60%). Study participants were primarily White and from predominantly White countries. Overall, 21 (66%) of the included studies provided information on parental education. Most of these studies had samples with moderate to high educational attainment. Behavioral sleep intervention studies to date include samples with insufficient diversity. Overall, this study highlights a critical gap in pediatric sleep intervention research and supports a call to further include families from diverse backgrounds when assessing behavioral sleep interventions.

Keywords: sleep; diversity; race; ethnicity; behavioral intervention; pediatrics; extinction; infant; children

Abbreviations

AUD	Australian dollar
BSI	behavioral sleep intervention
CAN	Canadian dollar
SES	socioeconomic status
PRISMA	preferred reporting items for systematic reviews and meta-analyses
PROSPERO	international prospective register of systematic reviews
RCT	randomized controlled trial

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Pediatric sleep problems are universal and impact families across racial, ethnic, and socioeconomic (SES) or educational backgrounds.[1, 2] Behavioral sleep interventions (BSIs) designed to support these families should likewise demonstrate efficacy across diverse samples. BSIs refer to a variety of strategies used to encourage self-soothing in young children and to reduce night wakings requiring parental intervention.[3] Common BSI approaches include extinction or modified extinction, and BSIs are common recommendation to families with young children, particularly in Western countries.[4]

Within the field of pediatric sleep medicine, minimal data exist on the diversity (or lack of diversity) of samples included in BSI efficacy studies. Without this knowledge, clinicians and researchers cannot, with confidence, recommend BSIs for all families. BSI efficacy may vary across diverse families, as race, ethnicity, and culture influence parental sleep expectations, child sleep location, parental trust in clinician advice, parental access to information, and nighttime feeding practices.[5-9] Similarly, the efficacy of BSIs in families with low SES resources may vary as a function of parental work and school commitments, child sleep location, and child media exposure.[10-13] Each of the studies highlighted above, demonstrate how sleep, especially early in life, is influenced by a variety of familial factors. Given the potential range in BSI efficacy among diverse families, the goal of this study was to investigate the gross level of diversity in BSI efficacy studies for young children—in order to assess whether the included samples reflect the wide range of families BSIs often serve.

We first reviewed the pediatric sleep literature for the presence of sleep problems in families across several racial and ethnic groups. Within this study, race and ethnicity classifications/categories follow the guidelines provided by the National Institutes of Health (NIH) in the United States and refer to the classification of individuals based on their geographic

heritage, ancestors, or culture. These classifications include American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, and White.[14] NIH also provides two categories for ethnicity: *Hispanic or Latino* and *Not Hispanic or Latino*. Sleep problems are common in White, Hispanic or Latino, Asian, and Black or African families.[2, 15-19] For example, chronic sleep curtailment or persistent short nighttime sleep duration is a documented behavioral sleep difference for Black or African, Latino or Hispanic, and Asian children.[11] In some studies, race was an explicit variable of interest and was measured directly from families.[2] In others, race was captured by country of origin [17] and reflected the predominant race or ethnicity of that country. Regardless of measurement approach, numerous studies support the overall presence of sleep problems in families from diverse racial and ethnic backgrounds. Given the well-documented support for the presence of sleep problems across diverse families, we expected that BSI efficacy studies would include White, Hispanic or Latino, Asian, and Black or African American families.

We also reviewed the pediatric sleep literature for sleep problems in families with varying SES resources. Indeed, pediatric sleep problems are common across families with high, middle, and low SES resources; however, some studies report significantly higher rates of sleep problems in families with low SES resources.[2, 19-21] For example, McLaughlin Crabtree and colleagues (2005) [2] assessed the sleep of 3,371 children ages 2 to 7 years. Children from families with less income had more sleep problems, more daytime sleepiness, and less nighttime sleep. Similarly, Rona et al. (1998) [19] assessed sleep in 14,372 young children and found more sleep problems in families with less maternal education (their index of SES resources). Moreover, within families with low SES resources, several additional factors can influence the sleep of young children including family chaos [22], sleep location crowding [23], food

insecurity [24], and neighborhood deprivation.[25] Inclusive of these factors, child sleep problems are documented across families with high, moderate, and low SES resources [26]. Thus, we hypothesized that BSI efficacy studies would include families with a similar range of SES resources. Within this study we do not mean to imply that all infant/child sleep problems could or should be addressed via a BSI, rather we aimed to assess the inclusion of diverse samples in BSI efficacy studies in young children.

Methods and Results

A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[27] This study was registered with the International Prospective Register of Systematic Reviews (PROSPERO), registration number CRD42017070146.

Study Selection

To be included in this systematic review, studies were required to meet the following criteria:

1. Study samples included children five years or younger and/or expectant mothers. This age group was selected as our study aim was to assess the diversity in BSI efficacy studies in young children. Further, BSI is widely considered to be an evidence-based approach for the treatment for bedtime problems and night wakings in young children [28] with less evidence supporting efficacy in other pediatric age groups.
2. Studies were published in peer-reviewed journals.
3. Studies were published in English.
4. Studies were published within the past 30 years.
5. Quantitative data were included in the study. Qualitative studies can provide strong and rich information for how, when, and why BSI are implemented, as well as on intervention development and tailoring. Qualitative studies were excluded; however, as there is debate

in the field as to whether qualitative data can be used to establish intervention efficacy, the focus on this review.

6. Studies included the evaluation of how a behavioral sleep intervention influenced child sleep. Studies that focused on only change in parenting behavior or sleep-related cognitions were excluded.
7. For longitudinal studies with reports in more than one article, the paper with the largest sample was included.
8. Aside from sleep concerns, studies included children who were otherwise typically developing (i.e., did not focus primarily on children with known neurodevelopmental disorders or risk, such as autism spectrum disorder, Fragile X syndrome, prematurity).

Data Sources and Searches

Online searches of PubMed (United States Library of Medicine), Web of Science Core Collection, PsycINFO (Wolters Kluwer Health OvidSP), and CENTRAL (Cochrane Central Register of Controlled Trials) databases were performed on January 4th, 2019 using the following search terms: sleep, intervention, behavioral, extinction, infant, and child. When available, filters were used to select additional search criteria, including clinical trials, pediatric samples, and English as the primary publication language.

Through this process, 672 potential articles were identified (Figure 1). Article titles and abstracts were initially screened for 1) the inclusion of samples with children five years and younger and/or expectant mothers and 2) the evaluation of a behavioral sleep intervention. If the study met these criteria (based on the title or abstract), the full text was then retrieved and reviewed. Additional studies (n = 18) were also considered for review by searching the reference section of each full-text article reviewed.

Data Synthesis and Analysis

The main variables of interest for this study were race, ethnicity, and family SES resources (e.g., education, family income). Secondary variables of interest were country of origin and type of behavioral intervention (e.g., information/education, support group/meeting, use of modified or classic extinction intervention approaches).

Variables of interest were not consistently reported across studies (i.e., parental years of education vs. degree received). To address these inconsistencies, we created a binary variable to distinguish between *White* and *diverse* participant groups, as well as between moderate to high and low SES resources. These classifications reflect the most common sample characteristics reported across studies (*White* and moderate to high SES resources). These classifications were not intended to rank the groups, but rather to provide a clear presentation of the diversity (or lack of diversity) across studies. If a study did not provide descriptive information for racial, ethnic, or SES variables, we attempted to contact the corresponding author to request additional information (summarized in Table 1). If detailed information was not available in the original dataset, we asked the author (if possible) to select one of our respective binary codes (detailed below).

Socioeconomic Resources. To assess the SES resources, we first noted what type of information was provided across all studies (e.g., two-parent family, college degree, years of education completed, family income, and occupation type). As illustrated in Table 2, the reported elements of SES resources varied greatly across studies, and we therefore could not identify one consistent SES variable. Regardless of the SES resource type reported, all studies are summarized in Table 2. To combine studies for further descriptive analyses, we chose the most commonly reported index of SES resources—parental education. To combine across studies that reported percentage of the sample with a degree and studies that reported mean years of

education, we created a dummy code. Values of (1) denote that 50% or more of the sample completed a college degree or a post-secondary education and values of (0) denote that less than 50% completed a college degree or post-secondary education. This ratio was built on US population estimates. Roughly half of US adults have a college degree or a post-secondary education. We intended for this to be a relatively easy standard to represent SES diversity within studies. With this 50/50 binary code, 22 of the 32 studies are included in the summary analyses (see below), rather than only 15 studies if reporting only percentage of the sample with a degree, and 6 studies if reporting mean years of education (see Table 2). Parental education is commonly used as an indicator of family SES resources within the pediatric sleep literature.[29] As argued in El-Sheikh et al. (2013) [29], the highest level of obtained education can be used as *one* approach to conceptualizing SES resources and reflects an approximate index of non-material resources— in this case skills or knowledge.[30] Parental education reflects only one element of SES resources; thus, further discussion of this variable will directly reference parental education rather than the more global term SES resources.

Race and Ethnicity. When authors reported the racial composition of their sample, we present it as such (Table 3); however, most studies did not provide sample racial information, or they provided only a rough summary. Without an existing standard for acceptable racial (or ethnic) diversity in research samples, we selected a ratio that builds on the percentage of White residence in the four countries in which the majority of studies were conducted: US (70%) Australia (77%), Canada (73%), and the UK (87%), per recent census data. As some of these studies were conducted decades earlier, when rates of individuals from minority racial groups were lower, an 80% threshold was used.

For ethnicity, only 13 participants across four studies [39, 56, 63, 64] were reported as *Hispanic or Latino*. Using NIH ethnicity standards, the participants from Brazil were classified as *Hispanic or Latino*; however, this is an external classification and we acknowledge that many individuals from Brazil do not self-identify as *Hispanic or Latino* given their historic European heritage (primarily from Portugal and Germany). This may be particularly true for individuals in the Pelotas region of Brazil—the location of the included study.[59] Given the low rates of reported ethnicity across studies, we did not create a dichotomous variable for ethnicity. Instead, all available data are described below.

Country of Study Origin. We extracted information on the country of origin for each study. We then estimated a rough racial composition based on the most prevalent race per that country's most recent census data. For example, we assumed that Adachi et al. [31] included a predominantly Asian sample because the data were collected exclusively in Japan. Our categorizations included predominantly Asian and predominantly White. Brazil was classified as predominantly White given the demographics of the study's catchment area—the southernmost region of Brazil—wherein 82% report a race of Branco (White Brazilin).

Intervention type. Each study evaluated a BSI in young children (between birth and five years of age) or expectant mothers. Each intervention was classified based on the inclusion of one or more of the following intervention types: (a) information/education; (b) support group/meeting; (c) modified extinction; (d) unmodified extinction; and/or (e) other. Studies did not need to have a comparison group to be included, but they did need to assess the efficacy of a BSI on child sleep. Informational/educational interventions included providing parents with information about infant or child sleep patterns and cycles, sleep-onset associations, settling techniques, and/or routines. This information was delivered via written materials, group teaching

sessions, and/or one-on-one health care professional meetings. Support group/meetings included interventions that provided weekly to monthly support meetings for parents and caregivers. Modified extinction approaches included the Ferber method, periodic checks on children, and graduated withdrawal of active parental presence and soothing at bedtime. Classic extinction included studies that instructed parents to prepare their child for sleep and leave without providing additional support throughout the night. The 'other' category captured interventions that blended strategies such as personalized coaching on parental reactions to infant crying, using 'non-feeding' settling techniques, and/or focal feedings.

Study Selection

Six hundred and seventy-two articles were retrieved from the database searches (Figure 1). First, duplicate titles and studies before 1989 were removed using automated filters. The remaining study titles and abstracts were examined by two separate coders. Codes included: (1) recommend for full-text review (yes or no) and (2) exclusion reasons (could indicate up to seven exclusion reasons, detailed below). Inter-rater agreement (Cohen's Kappa) was calculated for the full-text review code (k = .68) and each of the exclusion reasons (k range .72 - .99). Disagreements on full-text reviews (i.e., studies recommended by only one coder) were discussed at team meetings and final determinations were made by group consensus. One hundred and six full-text articles were downloaded and coded for inclusion (k = .72), exclusion reasons (k range .78 - .99), and the same disagreement procedure was followed. These coders then reviewed the reference list of the selected studies (a process called pearling) to see if any additional studies could be identified (n = 18 were recommended for full-text review). These studies went through the same process noted above.

In sum, excluded studies did not address BSIs efficacy (70%), did not include children five years of age or younger (33%), were duplicated across search engines (25%), focused on children with neurodevelopmental disorders or risks (23%), were not quantitative (e.g., they were case studies) (8%), were published more than 30 years ago (< 1%), and were excluded because they reported on an already included sample, but with fewer participants (< 1%). Excluded studies could fit several of the categories above (hence the total above 100%). No studies were removed because they were not in a peer-reviewed journal or were not in English, which likely reflects the selected search engines that include studies predominantly written in English and studies that require peer-review for database inclusion.

Once the final 32 studies were selected, two researchers independently coded each study for all *variables of interest* (intervention type, sample age and size, country of study origin, ethnicity, and parent education). Their agreement ranged from k = .69 to .99. All coding differences were discussed at consensus meetings. In total, 11% of the *variables of interest* codes were discussed and determined via group consensus.

Study Characteristics

For a summary of each included study, see Table 1. The studies included a total of 5,474 children from birth to 62 months of age. Twenty studies (69%) provided race or ethnicity information. Race or ethnicity information was provided in 14 (44%) of the original publications (or provided reference materials) and 6 authors (19%) provided this information via e-mail follow-up (Table 3). Twenty-four studies (75%) provided information on parental education (n = 23, 72% in the publication; n = 1, 3% from e-mail correspondence), summarized in Table 2. Country of origin could be coded across all studies.

Parental Education. Of the 21 studies with parental education information, 15 (71%) had samples wherein 50% or more of the sample completed a college degree or post-secondary education. For the six studies that reported parental education in years, the averages ranged from 14 to 17 years. In sum, families across most studies had moderate to high levels of education.

Race or Ethnicity. As illustrated in Figure 2, White was the most common racial group (78% of participants) and *Not Hispanic or Latino* was the most common ethnic group. This estimate draws only from the 16 studies (n = 3,908) that reported sample racial and/or ethnic composition. When extracting race or ethnicity from country of origin (with all studies included), 31 of the 32 studies were conducted in predominantly White countries (Figure 3). For the purposes of this review, Australia, New Zealand, and Brazil were classified as predominantly White based on census data. Admittedly, these regions are more diverse than the other predominantly White countries included. No studies were completed in African countries and only one study was conducted in South America (Brazil). Additionally, no studies incorporated race or ethnicity into their statistical approach to assessing BSI efficacy.

Discussion

Infant/child sleep problems are common in families with racial, ethnic, and SES diversity; however, BSI studies designed to serve families with sleep difficulties historically include samples that are predominantly White with moderate to high levels of education. This phenomenon is common in research and often reflects logistical and sometimes geographical study limitations. To provide families with the best BSIs for their children, researchers should include samples that are more diverse.

BSI use and recommendations vary across cultures and it should not be assumed that BSI recommendations are universal across countries or cultures. The goal of this paper is not to determine where or when a BSI could or should be used. Rather, we aimed to assess if the larger

field recommendations for BSIs are built on diverse and representative samples and if there is a mismatch between the populations that utilize BSIs and the populations/samples used to demonstrate their efficacy.

Notably, some of the studies (n = 12) included in this review were completed over 20 years ago. However, these studies inform contemporary clinical recommendations, which do not account for the lack of diversity used to establish these pediatric sleep medicine norms. When considering only studies published with the past 10 years, participant race or ethnic diversity is slightly higher, with 75% of participants reported as White (from the studies that reported race or ethnicity). For education, 75% of the reporting studies had samples wherein over half of parents had a college degree or post-secondary education. The noted improvements in reporting race, ethnicity, and SES information within the last 10 years is encouraging; however, BSI efficacy studies still do not truly reflect the diverse families they often aim to serve.

In an era of precision medicine and the application of interventions that uniquely fit families and patients, it is prudent to assess BSI efficacy using diverse samples. As demonstrated in this study, current BSI efficacy research does not adequately represent the wide range of families impacted by child sleep problems.[2, 16, 18] Previous studies highlight that these underrepresented families may be even more impacted by the negative developmental sequelae associated with pediatric sleep problems. This study is not meant to imply that behavioral sleep interventions do not work for diverse families—rather we hope to encourage researchers and clinicians to acknowledge this limitation and actively seek, design, and implement studies that incorporate diverse samples. Although we were unable to assess other measures of diversity such as culture, religion, housing, and family structure, future studies should also consider these important factors when striving to increase the diversity of samples in BSI efficacy research.

Increasing diversity in BSIs also goes beyond the samples used in efficacy studies. Historically, most BSIs were designed by White researchers or clinicians for White families with moderate to high SES resources. A growing body of research documents that culturally adapted interventions and parent training programs optimize outcomes for diverse families.[32-35] The BSI field can build on this literature and design or adapt interventions for diverse samples. For example, Mathews and colleagues (2016) [36] customized a safe sleep messaging program designed for African American families to successfully reduce risky sleep behaviors (in this case, soft bedding use). Interventions designed for diverse families and tested within diverse samples may maximize family acceptability, adherence and ultimately BSI success.

Although the concept of this study is unique, it is not without limitations. Most notably, the inclusion of studies only published in English likely biased our search to samples that were less diverse. Additionally, although our measures of diversity (race, ethnicity, and education) are a starting point for examining the diversity of samples included in BSI efficacy studies, these measures have limited the breadth and depth of our discussion surrounding diversity. We readily acknowledge that the categories of *White* and *diverse* are broad and do not fully capture family race, ethnic, or cultural elements. However, we felt the use of these categories, although flawed, was justified to allow us to assess diversity across BSI efficacy studies in young children. Additionally, our selection of 80/20 and 50/50 ratios for racial and educational diversity likely impacted our presentation of diversity. The use of alternative ratios could change the presentation of the provided results.

There may also be a selection bias within the included BSI studies, wherein families from diverse backgrounds may be less likely to implement or may be less interested in BSIs. We are not aware of research documenting this selection bias, and we are therefore assuming that the

pattern identified in this study reflects sampling techniques more than parental preference. This review was designed to capture a systematic selection of studies. It does not reflect all BSI efficacy studies published to date—only those captured by our search terms, filters, and specified inclusion/exclusion criteria. It is likely some studies are missing. Importantly, we do not believe the missing studies are systematically biased to exclude diverse samples, and therefore does not affect the overall findings of our study. Finally, our systematic search using criteria of children five years and younger limits the application of this study to the larger pediatric sleep field.

When interpreting the findings of this study, it is important to consider cultural sleep norms and how these norms influence parental expectations and actions surrounding child sleep. The use of BSIs is considered by many to be a part of Western parenting [37], and many cultures around the world may not value BSI as a method to improve child sleep. For example, families from predominantly Asian countries are more likely to room and bed-share than families in predominantly White countries. [17] Strong "Westernized" beliefs around childrearing that value the development of autonomy and setting schedules can predict increased use of strategies that involve ignoring young children's crying at bedtime.[37] Further, diverse groups within Western countries may have different parental beliefs and practices around sleep. For instance, Patrick and colleagues (2016) [12] reported comparable parental reports of sleep problems in Black and White preschool-aged children, but distinct differences in parental confidence and actions around sleep. Black parents were less likely to report a consistent bedtime routine and more likely to report sleep onset associations. Thus, less frequent utilization and/or acceptability of BSIs among diverse parents is one potential contributor to the lack of diversity in BSI research.

In sum, researchers examining BSI efficacy should work to incorporate samples that are more diverse, with metrics that extend beyond race, ethnicity, and education. The present study

highlights a discrepancy between the range of families with children who experience sleep problems and the diversity of samples included in the efficacy studies for interventions recommended by researchers, clinicians, and experts.

Practice Points

- Behavioral sleep interventions for infants and young children have not been studied in sufficiently diverse samples.
- The efficacy of behavioral sleep interventions is not established in diverse families and recommendations should be weighted accordingly.

Research Agenda

- This study highlights a critical need for diverse samples in behavioral sleep intervention efficacy studies.
- Family diversity including race, ethnicity, socioeconomic resources, culture, religion, housing, and family structure should be included in future behavioral sleep intervention studies.

References

*1. Gelis LA. Children's sleep in the context of socioeconomic status, race, and ethnicity. In: El-Sheikh M, editor. Sleep and Development. New York, NY: Oxford University Press; 2011.

2. McLaughlin Crabtree V, Beal Korhonen J, Montgomery-Downs HE, Faye Jones V, O'Brien LM, Gozal D. Cultural influences on the bedtime behaviors of young children. *Sleep Med* 2005;**6**:319-24.

3. Honaker, SM, Meltzer, LJ. Bedtime problems and night wakings in young children: an update of the evidence. *Paediatr Respir Rev* 2014;**15**:333-339.

4. Owens, JA. The practice of pediatric sleep medicine: Results of a community survey. *Pediatrics* 2001;**108**:E51.

5. Bathory E, Tomopoulos S, Rothman R, Sanders L, Perrin EM, Mendelsohn A, et al. Infant Sleep and parent health literacy. *Acad Pediatr* 2016;**16**:550-7.

6. Hwang SS, Rybin DV, Heeren TC, Colson ER, Corwin MJ. Trust in sources of advice about infant care practices: The SAFE study. *Matern Child Health J* 2016;**20**:1956-64.

7. Luijk MP, Mileva-Seitz VR, Jansen PW, van IMH, Jaddoe VW, Raat H, et al. Ethnic differences in prevalence and determinants of mother-child bed-sharing in early childhood. *Sleep Med* 2013;**14**:1092-9.

8. Provini LE, Corwin MJ, Geller NL, Heeren TC, Moon RY, Rybin DV, et al. Differences in infant care practices and smoking among hispanic mothers living in the United States. *J Pediatr* 2017;**182**:321-6 e1.

9. Sadeh A, Mindell J, Rivera L. "My child has a sleep problem": A cross-cultural comparison of parental definitions. *Sleep Med* 2011;**12**:478-82.

*10. Netsi E, Santos, I.S., Stein, A., Barros, F.C., Barros, A. J. D., & Matijasevich, A. A different rhythm of life: Sleep patterns in the first four years of life and associated socio-demographic characteristics in a large Brazilian birth cohort. *Sleep Medicine* 2017;**37**:77-87.

*11. Pena MM, Rifas-Shiman SL, Gillman MW, Redline S, Taveras EM. Racial/Ethnic and socio-contextual correlates of chronic sleep curtailment in childhood. *Sleep* 2016;**39**:1653-61.

*12. Patrick KE, Millet G, Mindell JA. Sleep differences by race in preschool children: The roles of parenting behaviors and socioeconomic status. *Behav Sleep Med* 2016;**14**:467-79.

13. Zambrano DN, Mindell JA, Reyes NR, Hart CN, Herring SJ. "It's not all about my baby's sleep": A qualitative study of factors influencing low-income African American mothers' sleep quality. *Behav Sleep Med* 2016;**14**:489-500.

14. National Institutes of Health. Racial and ethnic categories and definitions for NIH diversity programs and for other reporting purposes. (NIH Notice No. NOT-OD-15-089). 2015 [Available from: https://grants.nih.gov/grants/guide/notice-files/NOT-OD-15-089.html]

15. Cornelius LJ. Health habits of school-age children. *J Health Care Poor Underserved* 1991;**2**:374-95.

16. Harding SM. Prediction formulae for sleep-disordered breathing. *Curr Opin Pulm Med* 2001;**7**:381-5.

*17. Mindell JA, Sadeh A, Wiegand B, How TH, Goh DY. Cross-cultural differences in infant and toddler sleep. *Sleep Med* 2010;**11**:274-80.

18. Montgomery-Downs HE, Jones VF, Molfese VJ, Gozal D. Snoring in preschoolers: associations with sleepiness, ethnicity, and learning. *Clin Pediatr (Phila)* 2003;**42**:719-26.

19. Rona RJ, Li L, Gulliford MC, Chinn S. Disturbed sleep: effects of sociocultural factors and illness. *Arch Dis Child* 1998;**78**:20-5.

20. Nicholson JM, Lucas N, Berthelsen D, Wake M. Socioeconomic inequality profiles in physical and developmental health from 0-7 years: Australian National Study. *J Epidemiol Community Health* 2012;**66**:81-7.

21. Touchette E, Mongrain V, Petit D, Tremblay RE, Montplaisir JY. Development of sleep-wake schedules during childhood and relationship with sleep duration. *Arch Pediatr Adolesc Med* 2008;**162**:343-9.

22. Whitesell CJ, Crosby B, Anders TF, Teti, DM. Household chaos and family sleep during the infants' first year. *J Fam Psychol* 2018;**32**:622-631.

23. Luijk MP, Mileva-Seitz VR, Jansen PW, van IJzendoorn MH, Jaddoe VW, Raat H, Hofman, A, Verhulst FC, Tiemeier H. Ethnic differences in prevalence and determinants of mother-child bed-sharing in early childhood. *Sleep Med* 2013;**14**:1092-9

24. Na M, Eagleton S, Jomaa L, Lawton K, Savage J. Food insecurity associated with suboptimal sleep quality among low-income head start preschool-aged children. *Curr Dev Nutr* 2019;**13**: P04-071-19

25. Grimes M, Camerota M, Propper CB. Neighborhood deprivation predicts infant sleep quality. *Sleep Health* 2019;**5**:148-151

26. Sette S, Baumgartner E, Ferri R, Bruni O. Predictors of sleep disturbances in the first year of life: a longitudinal study. *Sleep Med* 2017;**36**:78-85.

*27. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015;**4**:1.

28. Mindell JA, Kuhn B, Lewin DS, Meltzer LJ, Sadeh A. Behavioral treatment of bedtime problems and night wakings in infants and young children. *Sleep* 2006;**29**:1263-76.

*29. El-Sheikh M, Bagley EJ, Keiley M, Elmore-Staton L, Chen E, Buckhalt JA. Economic adversity and children's sleep problems: multiple indicators and moderation of effects. *Health Psychol* 2013;**32**:849-59.

30. McLoyd VC. Socioeconomic disadvantage and child development. *Am Psychol* 1998;**53**:185-204.

31. Adachi Y, Sato C, Nishino N, Ohryoji F, Hayama J, Yamagami T. A brief parental education for shaping sleep habits in 4-month-old infants. *Clin Med Res* 2009;**7**:85-92.

32. Benish SG, Quintana S, Wampold BE. Culturally adapted psychotherapy and the legitimacy of myth: a direct-comparison meta-analysis. *J Couns Psychol* 2011;**58**:279-89.

33. Forehand R, Kotchick BA. Cultural Diversity: A wake-up call for parent training - republished article. *Behav Ther* 2016;**47**:981-92.

34. Lau AS. Making the case for selective and directed cultural adaptations of evidence□ based treatments: Examples from parent training. *Clinical Psychology: Science and Practice* 2016;**13**:295-310.

35. Martinez CR, Jr., Eddy JM. Effects of culturally adapted parent management training on Latino youth behavioral health outcomes. *J Consult Clin Psychol* 2005;**73**:841-51.

36. Mathews A, Joyner BL, Oden RP, He J, McCarter R, Jr., Moon RY. Messaging affects the behavior of African American parents with regards to soft bedding in the infant sleep environment: A randomized controlled trial. *J Pediatr* 2016;**175**:79-85 e2.

37. Maute M, Perren S. Ignoring children's bedtime crying: The power of western-oriented beliefs. *Infant Ment Health J* 2018;**39**:220-230

38. Adair R, Zuckerman B, Bauchner H, Philipp B, Levenson S. Reducing night waking in infancy: a primary care intervention. *Pediatrics* 1992;**89**:585-8.

39. Adams LA, Rickert VI. Reducing bedtime tantrums: comparison between positive routines and graduated extinction. *Pediatrics* 1989;**84**:756-61.

40. Blunden S. Behavioural treatments to encourage solo sleeping in pre-school children: an alternative to controlled crying. *J Child Health Care* 2011;**15**:107-17.

41. Crncec R, Cooper E, Matthey S. Treating infant sleep disturbance: does maternal mood impact upon effectiveness? *J Paediatr Child Health* 2010;**46**:29-34.

42. Eckerberg B. Treatment of sleep problems in families with small children: is written information enough? *Acta Paediatr* 2002;**91**:952-9.

43. Galland BC, Sayers RM, Cameron SL, Gray AR, Heath AM, Lawrence JA, et al. Anticipatory guidance to prevent infant sleep problems within a randomised controlled trial: infant, maternal and partner outcomes at 6 months of age. *BMJ Open* 2017;**7**:e014908.

*44. Gradisar M, Jackson K, Spurrier NJ, Gibson J, Whitham J, Williams AS, et al. Behavioral interventions for infant sleep problems: A Randomized controlled trial. *Pediatrics* 2016;**137**.

*45. Hall WA, Saunders RA, Clauson M, Carty EM, Janssen PA. Effects of an intervention aimed at reducing night waking and signaling in 6- to 12-month-old infants. *Behav Sleep Med* 2006;**4**:242-61.

46. Hall WA, Hutton E, Brant RF, Collet JP, Gregg K, Saunders R, et al. A randomized controlled trial of an intervention for infants' behavioral sleep problems. *BMC Pediatr* 2015;**15**:181.

47. Hauck YL, Hall WA, Dhaliwal SS, Bennett E, Wells G. The effectiveness of an early parenting intervention for mothers with infants with sleep and settling concerns: a prospective non-equivalent before-after design. *J Clin Nurs* 2012;**21**:52-62.

*48. Hiscock H, Wake M. Randomised controlled trial of behavioural infant sleep intervention to improve infant sleep and maternal mood. *BMJ* 2002;**324**:1062-5.

49. Hiscock H, Bayer JK, Hampton A, Ukoumunne OC, Wake M. Long-term mother and child mental health effects of a population-based infant sleep intervention: cluster-randomized, controlled trial. *Pediatrics* 2008;**122**:e621-7.

50. Kerr SM, Jowett SA, Smith LN. Preventing sleep problems in infants: a randomized controlled trial. *J Adv Nurs* 1996;**24**:938-42.

51. Matthey S, Crncec R. Comparison of two strategies to improve infant sleep problems, and associated impacts on maternal experience, mood and infant emotional health: a single case replication design study. *Early Hum Dev* 2012;**88**:437-42.

52. Mindell JA, Du Mond CE, Sadeh A, Telofski LS, Kulkarni N, Gunn E. Efficacy of an internet-based intervention for infant and toddler sleep disturbances. *Sleep* 2011;**34**:451-8.

53. Paul IM, Savage JS, Anzman-Frasca S, Marini ME, Mindell JA, Birch LL. INSIGHT responsive parenting intervention and infant sleep. *Pediatrics* 2016;**138**.

54. Pinilla T, Birch LL. Help me make it through the night: behavioral entrainment of breast-fed infants' sleep patterns. *Pediatrics* 1993;**91**:436-44.

55. Pritchard AA, Appleton P. Management of sleep problems in pre□school children: Effects of a behavioural programme on sleep routines, maternal depression and perceived control. *Early Child Development and Care* 1988;**34**:227-40.

56. Reid MJ, Walter AL, O'Leary SG. Treatment of young children's bedtime refusal and nighttime wakings: a comparison of "standard" and graduated ignoring procedures. *J Abnorm Child Psychol* 1999;**27**:5-16.

57. Rickert VI, Johnson CM. Reducing nocturnal awakening and crying episodes in infants and young children: a comparison between scheduled awakenings and systematic ignoring. *Pediatrics* 1988;**81**:203-12.

58. Sadeh A. Assessment of intervention for infant night waking: parental reports and activity-based home monitoring. *J Consult Clin Psychol* 1994;**62**:63-8.

59. Santos IS, Bassani DG, Matijasevich A, Halal CS, Del-Ponte B, da Cruz SH, et al. Infant sleep hygiene counseling (sleep trial): protocol of a randomized controlled trial. *BMC Psychiatry* 2016;**16**:307.

60. Scott G, Richards MP. Night waking in infants: effects of providing advice and support for parents. *J Child Psychol Psychiatry* 1990;**31**:551-67.

61. Seymour FW, Brock P, During M, Poole G. Reducing sleep disruptions in young children: evaluation of therapist-guided and written information approaches: a brief report. *J Child Psychol Psychiatry* 1989;**30**:913-8.

62. St James-Roberts I, Sleep J, Morris S, Owen C, Gillham P. Use of a behavioural programme in the first 3 months to prevent infant crying and sleeping problems. *J Paediatr Child Health* 2001;**37**:289-97.

63. Stremler R, Hodnett E, Lee K, MacMillan S, Mill C, Ongcangco L, et al. A behavioral-educational intervention to promote maternal and infant sleep: a pilot randomized, controlled trial. *Sleep* 2006;**29**:1609-15.

64. Stremler R, Hodnett E, Kenton L, Lee K, Weiss S, Weston J, et al. Effect of behavioural-educational intervention on sleep for primiparous women and their infants in early postpartum: multisite randomised controlled trial. *BMJ* 2013;**346**:f1164.

65.Symon B, Bammann M, Crichton G, Lowings C, Tucsok J. Reducing postnatal depression, anxiety and stress using an infant sleep intervention. *BMJ Open* 2012;**2**.

66.Weir IK, Dinnick S. Behaviour modification in the treatment of sleep problems occurring in young children: a controlled trial using health visitors as therapists. *Child Care Health Dev* 1988;**14**:355-67.

67.Wilson KE, Miller AL, Bonuck K, Lumeng JC, Chervin RD. Evaluation of a sleep education program for low-income preschool children and their families. *Sleep* 2014;**37**:1117-25.

68.Wolfson A, Lacks P, Futterman A. Effects of parent training on infant sleeping patterns, parents' stress, and perceived parental competence. *J Consult Clin Psychol* 1992;**60**:41-8.

69.Hallal PC, Bertoldi AD, Domingues MR, da Silveira MF, Demarco FF, da Silva ICM, et al. Cohort profile: The 2015 pelotas (Brazil) birth cohort study. *Int J Epidemiol* 2018;**47**:1048-h.

Table 1

Descriptive elements of reviewed studies

Study	N	Age Range (months)	Study Design	Type(s) of Intervention	Control or Comparison Group	Race or Ethnicity Report	Education Report	Country of Origin
Adachi et al., 2009 [31]	194	4-7	Prospective cohort	Information/education	Control	Not reported	Not reported	Japan
Adair et al., 1992 [38]	292	4-9	Prospective cohort	Information/education	Control	Published	Published	USA
Adams & Rickert, 1989 [39]	38	18-48	RCT	Information/education, Modified extinction	Control	Published	Published	USA
Blunden, 2011 [40]	39	8-51	Single group pre- and posttest	Other	Neither	Not reported	Published	Australia
Crncec et al., 2010 [41]	90	5-12	Retrospective chart review	Modified extinction	Neither	Published	Not reported	United Kingdom
Eckerberg, 2002 [42]	76	4-18	RCT	Information/education, Support group/meeting, Modified extinction	Comparison	Published	Published	Sweden
Galland et al., 2017 [43]	802	Birth-6 months	RCT	Information/education	Control	Published	Published	New Zealand

Gradisar et al., 2016 [44]	43	6-16	RCT	Information/education, Modified extinction, Other	Control	Not reported	Published	Australia
Hall et al., 2006 [45]	39	6-10.5	Single-group pre- and posttest	Information/education, Modified extinction	Neither	Published	Published	Canada
Hall et al., 2015 [46]	235	6-8	RCT	Information/education, Modified extinction	Control	Published	Published	Canada
Hauck et al., 2012 [47]	178	4-6	Prospective, pre- and posttest	Other	Control	Not reported	Published	Australia
Hiscock & Wake, 2002 [48]	156	6-12	RCT	Information/education, Modified extinction	Control	Provided via email	Published	Australia
Hiscock et al., 2008 [49]	328	4-24	Cluster Randomized Trial	Information/education, Modified extinction, Other	Control	Not reported	Published	Australia
Kerr et al., 1996 [50]	202	3	RCT	Information/education	Control	Not reported	Not reported	United Kingdom
Matthey & Crncec, 2012 [51]	33	6-18	Single-case replication design	Modified extinction	Comparison	Provided via email	Provided via email	Australia
Mindell et al., 2011 [52]	272	6-36	RCT	Information/education	Control	Provided via email	Published	USA
Paul et al., 2016 [53]	279	.5-12	RCT	Information/education	Control	Published	Published	USA

Pinilla & Birch, 1993 [54]	33	Birth	RCT	Other	Control	Provided via email	Published	USA
Pritchard & Appleton, 1988 [55]	31	9-42	RCT	Information/education, Support group/meeting	Comparison	Not reported	Not reported	United Kingdom
Reid et al., 1999 [56]	49	16-48	RCT	Modified extinction, Classic extinction	Control	Published	Published	USA
Rickert & Johnson, 1988 [57]	50	6-54	RCT	Classic extinction, Other	Control	Not reported	Published	USA
Sadeh, 1994 [58]	50	9-24	RCT	Modified extinction, Other	Comparison	Not reported	Not reported	Israel
Santos et al., 2016 [59]	552	3-24	RCT	Information/education	Control	Published[a]	Published[a]	Brazil
Scott & Richards, 1990 [60]	120	1-18	RCT	Information/education, Support group/meeting	Control	Provided via email	Published	United Kingdom
Seymour et al., 1989 [61]	45	9-60	RCT	Information/education, Classic extinction	Control	Not reported	Not reported	New Zealand
St. James Roberts, 2001 [62]	610	Birth-9	RCT	Information/education, Other	Control	Published	Published	United Kingdom
Stremler et al., 2006 [63]	30	Birth-3	RCT	Information/education	Control	Published	Published	Canada

Stremler et al., 2013 [64]	246	Birth	RCT	Information/education	Control	Published	Published	Canada
Symon et al., 2012 [65]	99	6-12	RCT	Information/education	Neither	Provided via email	Not reported	Australia
Weir & Dinnick, 1988 [66]	51	4-54	RCT	Other	Control	Not reported	Not reported	United Kingdom
Wilson et al., 2014 [67]	152	34-62	RCT	Information/education	Control	Published	Published	USA
Wolfson et al., 1992 [68]	60	Birth-3	RCT	Information/education	Control	Not reported	Published	USA
Total/Range	5,474	Birth – 62	RCT = 24 (75%)	Info/edu = 23 (72%) Support group = 3 (9%) Modified ext = 11 (34%) Classic ext = 3 (9%) Other = 9 (28%)	24 Control (75%)	Published 14 (44%) Via e-mail 6 (19%)	Published 23 (72%) Via e-mail 1 (3%)	Coded 32 (100%)

Note. RCT = Randomized controlled trial, [a] Details for this cohort were published in reference manuscript [69], Not reported = this information was not provided in the article text and the corresponding author either did not respond to our e-mail request or we were unable to locate a current e-mail address.

Table 2

Study socioeconomic reports for participants

Study	Education (*M* Years)	Degree	Income	Other	Notes
Adachi et al., 2009 [31]				X	Mothers employed outside of home (24-30%)
Adair et al., 1992 [38]		X		X	Parent some high school (8%), high school (46%), college degree (46%) Parent gainfully employed (31%)
Adams & Rickert, 1989 [39]				X	11% single; 89% married
Blunden, 2011 [40]	14.3			X	90% "undertaking" higher education
Eckerberg, 2002 [42]		X			11% elementary schooling, 71% upper secondary schooling, 18% higher education
Galland et al., 2017 [43]		X			Maternal secondary schooling (24%), Postsecondary (15%), college degree or higher (61%)
Gradisar et al., 2017 [44]		X	X		Maternal less than high school (2%), high school diploma (14%), completed higher education (79%); Household AUD Income < $50,000 (16%), $50,000-$80,000 (30%), > $80,000 (44%)
Hall et al., 2006 [45]	16.7		X		Household CAN income (Range, $10,000 to >$110,000, majority = $60,000 to $89,000)
Hall et al., 2015 [46]	17.0		X	X	Household CAN income (Range, $10,000 to > $110,000; M = $90,000)
Hauck et al., 2012 [47]		X		X	Parent college degree (63%), Parent living with partner (95%)

Study	Education (*M* Years)	Degree	Income	Other	Notes
Hiscock & Wake, 2002 [48]		X			Parent college degree (67%)
Hiscock et al. 2008 [49]		X		X	Parent postgraduate degree (50%), parent high school diploma (32%), less than high school (17%); index of high (18%), medium (32%), and low (50%) social disadvantage
Mindell et al., 2011 [52]		X	X	X	Parent high school (7%), some college (29%), college degree or higher (64%); Household income: < $30,000 (4%), $30,000 - $39,999 (16%), $40,000 - $49,999 (10%), $50,000 - $74,999 (34%) $75,000 – 99,000 (21%), $100,000 or more (14%) Employment: none (50%), part time (24%), full time (27%)
Paul et al. 2016 [53]		X	X		Parent high school or less (11%), some college (26%), college degree or higher (62%); Household income: < $10,000 (4%), $10,000 - $24,999 (10%), $25,000 - $49,999 (10%), $50,000 - $74,999 (26%) $75,000 – 99,999 (20%), $100,000 or more (27%)
Pinilla & Birch, 1993 [54]	16.4[a]				
Pritchard & Appleton, 1988 [55]				X	9 from council estates, 22 owner occupiers
Reid et al., 1999 [56]	14.5[a]		X		Average household income: $55,800
Rickert & Johnson, 1988 [57]		X		X	22% single parent, 93% at least one parent employed Parent some high school (3%), high school (44%), college degree (36%), graduate degree (12%)

Study	Education (*M* Years)	Degree	Income	Other	Notes
Sadeh, 1994 [58]				X	"Middle-class, intact families"
Santos et al., 2016 [59]				X	Maternal education 1-4 years (9%), 5-8 years (26%), more than 9 years (65%)
Scott & Richards, 1990 [60]		X		X	Parent college degree (30-33%), Paid employment (20-30%), single parent (3-7%)
Seymour et al., 1989 [61]				X	93% two-parent family
St. James Roberts, 2001 [62]		X		X	Parent college degree (34-47%) Most in managerial/technical or non-manual skilled jobs; < 10% unemployed
Stremler et al., 2006 [63]		X			Parent secondary education (7%); Post-secondary (93%)
Stremler et al., 2013 [64]		X			Elementary (2%); high school (7%); college degree (65%); graduate degree (25.6%)
Symon et al., 2012 [65]				X	"The Socio-economic Index for Disadvantage was used to assess socio-economic status, and there was an even spread across all postcodes with no bias towards any advantage or disadvantage."
Weir & Dinnick, 1998 [66]				X	Two-parent homes 92-96%; social class non-manual 85-90%, owner-occupier 61-72%
Wilson et al., 2014 [67]		X			Maternal education less than or equal to high school (94%)
Wolfson et al., 1992 [68]	15.7[a]				
Total[b]	6 (19%)	15 (47%)	6 (19%)	17 (53%)	

Note. [a]Averaged across mothers and fathers; [b] % of the 32 studies included in this systematic review; The information in this table reflects information provided in the original manuscript and does not include binary demographic information provided by authors via

email. Income estimates reported reflect United States dollars unless otherwise specified. AUD = Australian dollar, CAN = Canadian dollar.

Table 3

Study race and ethnicity reports

Study	*n*	Asian	Black or African	Hispanic or Latino	Pacific Islander[a]	White	Unreported, Other, or reported as 'not-White'
Adair et al., 1992 [38]	292					283 (97%)[b]	9 (3%)[b]
Adams & Rickert, 1999 [39]	38			4 (11%)[c]		34 (89%)[c]	
Crncec et al., 2010 [41]	90					50 (56%)[d]	40 (44%)[d]
Galland et al., 2017 [43]	801	48 (6%)			95 (12%)	625 (78%)	33 (4%)
Hall et al., 2006 [45]	78	20 (26%)[e]				48 (61%)[e]	10 (13%)[e]
Hall et al., 2015 [46]	452	83 (18%)[e]				289 (64%)[e]	80 (18%)[e]
Paul et al. 2016 [53]	279	9 (3%)	17 (6%)		1 (<1%)	249 (89%)	3 (1%)
Pinilla & Birch, 1993 [54]	26					26 (100%)[c]	
Reid et al., 1999 [56]	43	1 (2%)[b]	1 (2%)[b]	1 (2%)[b]		40 (93%)[b]	
Santos et al., 2016 [59]	552		55 (10%)	552 (100%)		452 (82%)	40 (7%)
Scott & Richards, 1990 [60]	120					108 (90%)[b]	12 (10%)[b]
St. James Roberts, 2001 [62]	610					573 (94%)[d]	37 (6%)[d]
Stremler et al., 2006 [63]	30	5 (17%)[d]		1 (3%)[d]		23 (77%)[d]	1 (3%)[d]
Stremler et al., 2013 [64]	246	49 (20%)[d]	17 (7%)[d]	7 (3%)[d]		156 (63%)[d]	17 (7%)[d]
Symon et al., 2012 [65]	99					74 (75%)[d]	25 (25%)[d]

Wilson et al., 2014 [67]	152		151 (99%)[f]				
Total[g]	3908	215 (6%)	241 (6%)	565 (14%)	96 (2%)	3030 (78%)	307 (8%)

Note. Studies included in this table reported at a minimum the % of their sample that was White. Studies that only included a binary code for race (> or < 80% *White*) via e-mail are not included. [a] Includes Maori, aboriginal people of New Zealand, [b] % of children in original study sample; [c] % of families in original study sample; [d] % of mothers in original study sample; [e] % of both parents in original study sample; [f] quantitatively described as a "minority group", qualitatively described as "predominantly black", [g] % of all studies combined. For *North American Indian or Alaska Native* the cumulative total is zero.

Figure 1. Flowchart of study inclusion.

Note. Pearling includes reviewing the reference lists of the articles that met study criteria.

Figure 2. Racial composition from the sixteen reporting studies.

Note. Studies included in this figure reported at a minimum the % of their sample that was White. Studies that only included a binary code for race (> or < 80% White) via e-mail are not included. Within the "Unreported, Other, or Reported as 'not white' group", two individuals were reported as multi-racial. For *American Indian or Alaska Native* the cumulative total is zero.

Figure 3. Country of origin and combined sample sizes for the surveyed pediatric behavioral sleep intervention studies.